DOE National Strategic Plan for the Management of Nuclear Materials

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FY2011

National Strategic Plan for Nuclear Materials

A New Era

U.S. Department of Energy

Nuclear Materials Strategic Plan

- Entering a new era
  - new beneficial uses of isotopes
  - smaller federal nuclear complex
  - increased security requirements
- Consolidating nuclear materials and disposing of excess
- Preserving rare, valuable isotopes
- Producing and supplying needed isotopes

Vision

Simple to state but challenging to achieve

The vision for management of nuclear materials is that throughout their lifecycles, required forms of nuclear materials are available when needed and are properly disposed of when no longer required.

Goals

- **Assured Supply**
  - *Identify demand for nuclear materials for the foreseeable future.*
  - *Assess available supply of required nuclear materials in the required forms and locations.*
  - *Develop strategies for resolving any material supply shortages related to forms, locations, or crosscutting activities involving such things as transportation and packaging; production, process, analytical, and storage facilities; and core competencies.*
  - *Develop capital acquisition projects if needed, to implement supply strategies.*

- **Consolidation & Disposition of Excess**
  - *Identify and characterize all excess and surplus materials.*
  - *Confirm existence of disposition paths for all excess and surplus materials.*
  - *Develop disposition paths where none presently exist.*
  - *Consolidate storage of excess awaiting disposition.*
  - *Develop capital acquisition projects if needed , to implement consolidation & disposition strategies.*

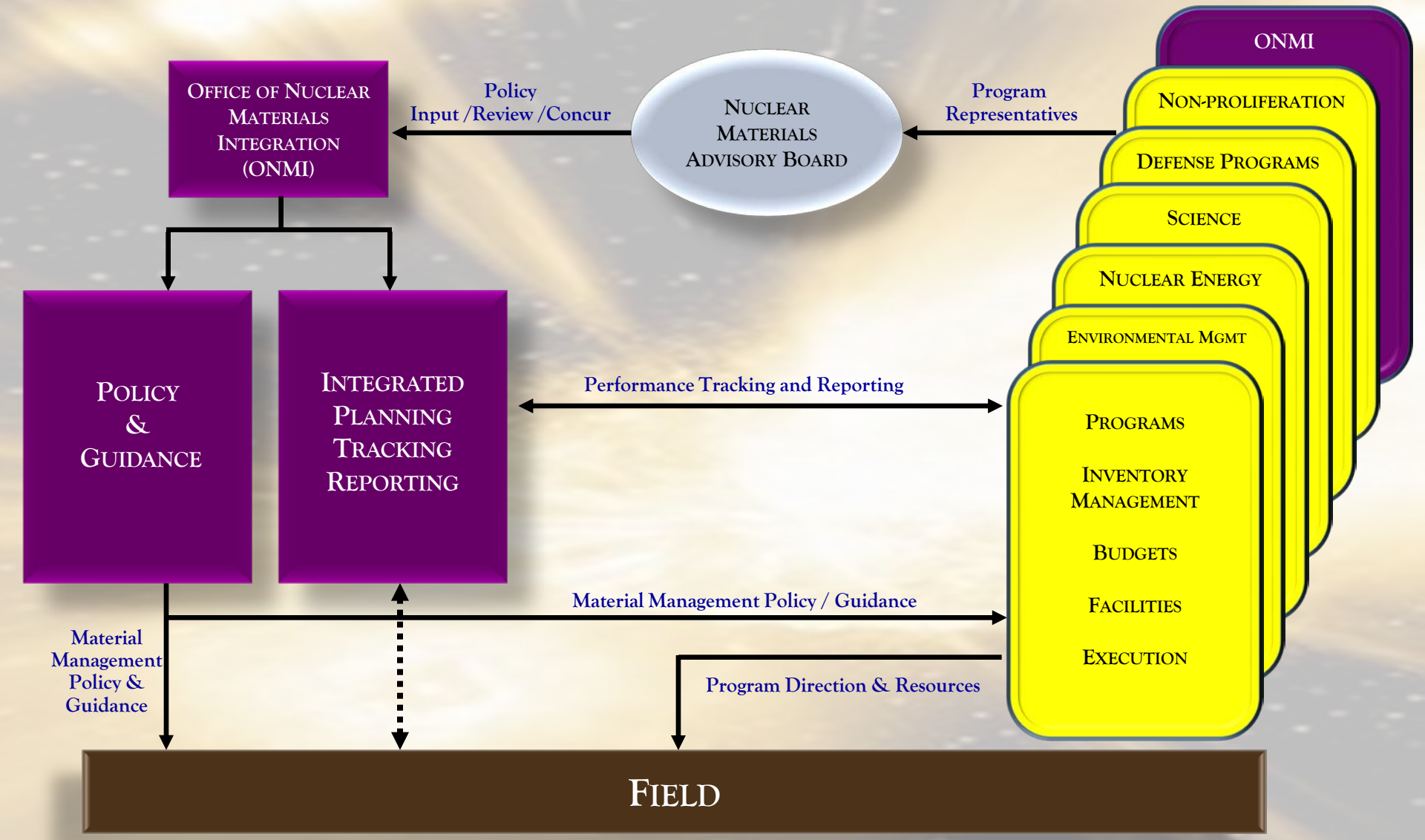
Key Takeaways

- For almost a decade, our laboratories and facilities have been underfunded and undervalued. The consequences of this neglect—like the growing shortage of skilled nuclear scientists and engineers and the aging of critical facilities—have largely escaped public notice.
- Nuclear materials management is central to the national security responsibilities of the department.
- Nuclear materials are intimately involved in research efforts to produce low carbon energy science and technology.
- Responsible use of nuclear materials provides other benefits which improve the health and prosperity of the nation. The Department plays a crucial role in assuring these benefits can be attained while reducing the risk of misuse of nuclear materials.
- Must be properly handled and not misused.
- To be successful in meeting our obligations to the nation we must make nuclear materials available when and where needed, handle and store them safely and securely, promote non-proliferation, and prevent unintentional release to the environment.
- Nuclear materials management is practically impossible – but not completely impossible

Future Opportunities

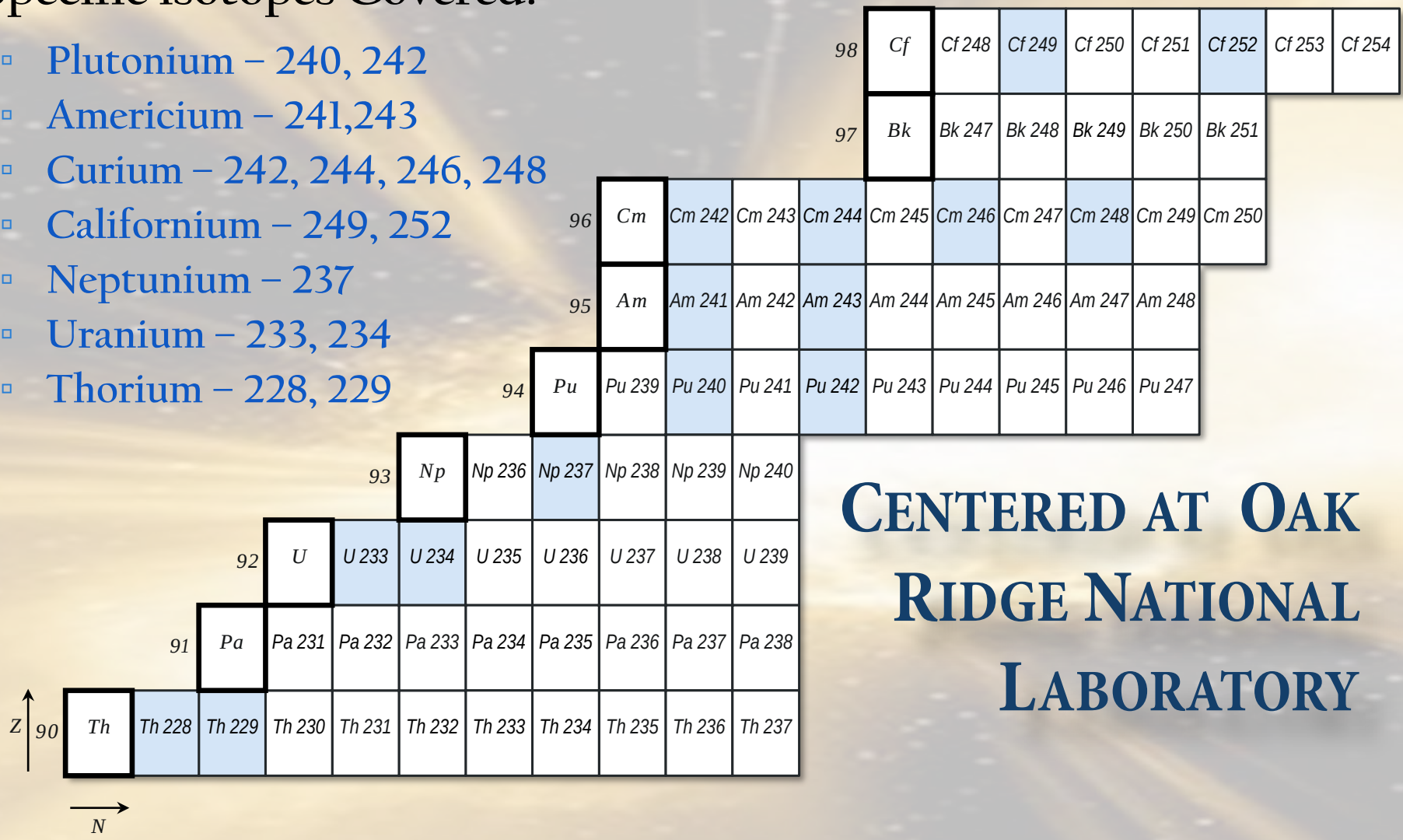
- Accelerate stabilization, consolidation and disposition of nuclear materials at LANL, Y-12, INL;
- Consolidate and disposition "orphan" materials at DOE and other sites (e.g., universities, commercial industry);
- Develop disposition paths for materials which currently have none; (e.g., expanded use of direct disposal of excess materials);
- Accelerate value added disposition of excess non-nuclear materials;
- Develop robust strategic material management program to ensure supply of unique materials for future missions; and
- Develop a standardized Departmental reporting system to status key metrics in nuclear materials management.

Material Management Framework



Heavy Isotope LMMO Established - *July 20, 2012*

- Specific isotopes Covered:
  - Plutonium – 240, 242
  - Americium – 241,243
  - Curium – 242, 244, 246, 248
  - Californium – 249, 252
  - Neptunium – 237
  - Uranium – 233, 234
  - Thorium – 228, 229

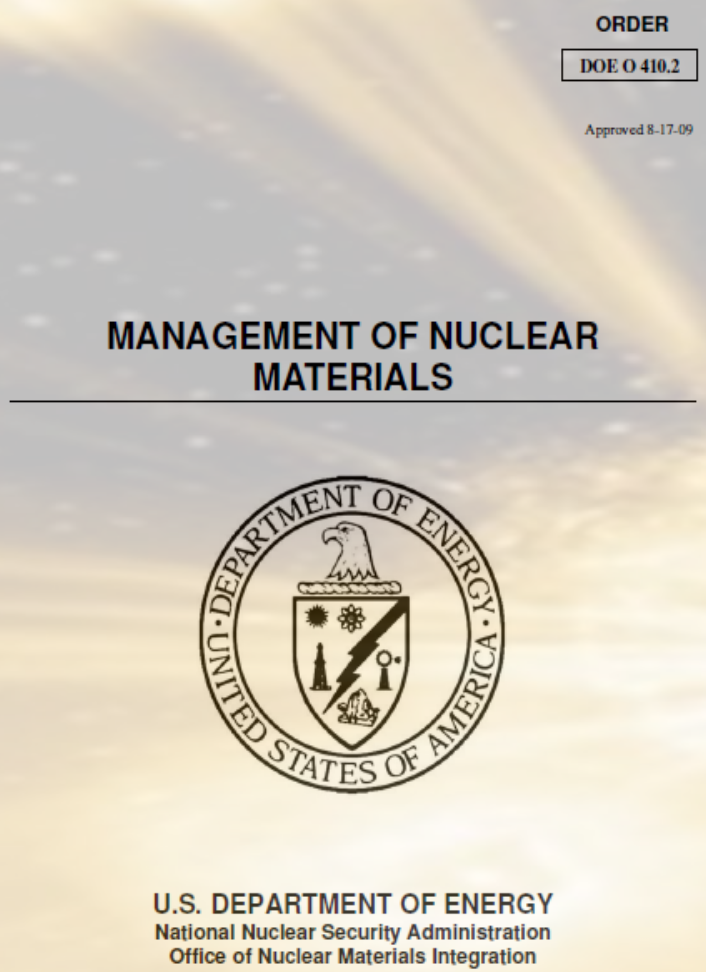


Centered at Oak Ridge National Laboratory

ORNL Heavy Isotopes Long History

- Enriched Heavy Isotopes, 1962–1982
  - Th, U, Pu, Am, and Cm
- National Heavy Element Program, 1957–present
  - Uses ^{242}Pu, ^{243}Am, and ^{244}Cu feedstock
- Irradiation of ^{249}Bk, ^{241}Am, ^{253}Es, and ^{237}Np
  - for specialty isotopes
- ^{252}Cf Industrial Sales Program Lease/Loan Program, 1969 – Present
- Mark-18A and -42 Processing, 1991–2006;
  - Separated ^{242}Pu, ^{244}Pu, ^{244}Cm, and ^{243}Am

Material Specific Management Plan (MSMP)


ORDER

DOE O 410.2

Approved 8-17-09

MANAGEMENT OF NUCLEAR MATERIALS

U.S. DEPARTMENT OF ENERGY
National Nuclear Security Administration
Office of Nuclear Materials Integration

- ✓ Requirement in DOE Order 410.2, Management of Nuclear Materials
- ✓ Supports the National Strategic Plan for Nuclear Materials
- ✓ Participation from stakeholders and SMEs across DOE to provide enterprise-wide perspective

Future Heavy Isotope MSMPs

- MSMPs will be developed for all in-scope* heavy isotopes
  - Three year cycle to support *National Strategic Plan for Nuclear Materials*

Fiscal Year	MSMP Topic
2013	Americium-241
2014	Curium -242, -244, -246, -248 and Americium-243
	Plutonium-240, -242
2015	Californium-249-252
	Neptunium-237
2016	Uranium-234 and Thorium-228,-229
	Uranium-233

*Scope established by Chartering Document 7/20/2012

MSMP Highlights for Am-241

- The amount of separated, usable Am-241 in use within DOE is ~725 grams
- Additional Am-241 material is needed for
  - DOE Fuel Cycle Research and Development (FCR&D) within DOE
  - IDPRA for commercial sales
- Proposed processing at INL will meet DOE demand
- Isotope Development & Production for Research & Applications (IDPRA) is evaluating opportunities to meet commercial demand

Next Steps

- Identify specific DOE internal and commercial demand beyond 2022, and potential alternative sources
- Incorporate plans for saving (rather than discarding) feed material into the plutonium disposition projects at a level and rate consistent with the proposed material quantity demand ranges
- Continue to improve and document estimates of Am-241 inventory that is unseparated, but potentially useful as production feed material

Closeout of the Cf-252 Loan/Lease Program

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Applications

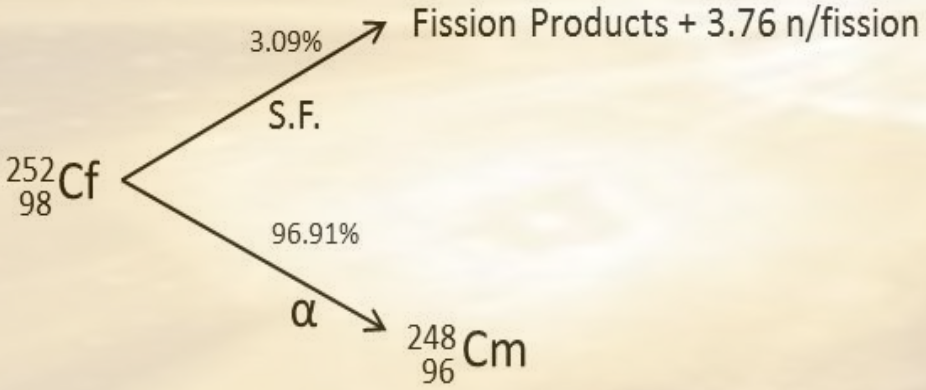
- Packaged in sealed containers
- Used as neutron sources
  - Radiography
  - Well logging
  - Nuclear reactor start-up
  - Instrument calibration
  - Cancer therapy
  - Prompt gamma neutron activation analysis (PGNAA)
  - Education

ORNL and RIAR are the only producers

ORNL provides about 70% of the world's Cf-252

CALIFORNIUM-252

- First isolated in 1952 in Ivy-Mike explosion
- 2.645 y half-life
- 2.3×10^6 n/μg/s



CF-252 Loan/Lease Program

Background

- Cf-252 Loan/Lease Program
  - Program to allow low-cost access by government agencies, qualified government contractors, and medical centers to Cf-252 sealed sources
    - Allowed users to borrow or lease Cf-252 sealed sources
    - Loans or leases spanned 1-5 years, and were renewable
    - Customers paid a low fee to cover some shipping and handling costs, but paid nothing for the Cf-252
  - Sources were to be returned at the end of the loan or lease

Current Status

- Loan program has been in a suspended state since 2009, awaiting decision on its fate (Resume? Retool? Close?)
- Loaned or leased inventory
  - 59 customers on record (47 sites)
  - 57 customers hold 220 loaned/leased sources
  - 2 customers handed over their sources (1 each) to DOE's Off-Site Source Recovery Project (University of Maryland, 2009; Edinboro University, 2011)
- Stored inventory
  - 336 sealed sources stored at ORNL in a storage pool (many of these owned by the Cf-252 Loan/Lease Program)
- No new sources manufactured for loan or lease in many years
- No new loan or lease agreements have been executed
- ORNL hasn't been able to accept source returns from customers since regular program funding ended

Where We Are

- In 2012, DOE selected to close out the loan program
- Desired End State
  - All sources recovered from non-DOE customers
  - All sources at DOE sites are recovered or reassigned to other active DOE programs
  - Stored sources valuable to other DOE programs are reassigned
  - Unneeded sources are disposed to Nevada National Security Site (NNSS) or Waste Isolation Pilot Plant (WIPP)
  - No sources remain in the program inventory at end of closeout
  - All loan or lease agreements closed

Project Proposals

- Mk-42 Segment Processing to Recover Pu-242
- Enrichment Study for Minor Plutonium Isotopes (Pu-242 and Pu-244)

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Potential Recovery of Heavy Isotopes of Interest

- Recovery of Material from Mk-18A Targets Stored at SRS
  - Heavy Curium (680 grams) high in Cm-246-248 content for Cf-252 production
  - Pu-244 (20 grams) of interest for spikes and tracers (requires enrichment)
- Recovery of Material from Mk-42 Targets Stored at ORNL
  - Isotopically pure Pu-240 (80 grams)
  - Pu-242 (575 grams plutonium) with greater than 75% Pu-242

Mk-42 Segment Processing to Recover Pu-242

Description

Recover Pu-242 contained in 14 Mk-42 "Middle" segments stored at ORNL - 574 grams of Pu with 76.8% Pu-242

Proposed Milestones

Activities	Due Date
Develop plan for FY14 Mk-42 segment processing	2/28/2014
Complete first 7 "Middle" segment campaign	9/30/2015
Complete second 7 "Middle" segment campaign	12/30/2016
Package and ship Pu-242 product	3/31/2017
Complete process waste disposition	9/30/2017

Benefits

- Unprocessed Mk-42 segments have been determined to be excess to NNSA programmatic needs
- These unique materials were made by irradiation of Pu-239 to very high burn-up (~86%) and will never be made again
- The Mk-42 segments will be processed to recover Pu-242 for Defense Programs, eliminate the present NNSA legacy, and establish a DOE asset

Enrichment Study for Minor Plutonium Isotopes (Pu-242 and Pu-244)

Description:

A study will be conducted to determine options for enriching Pu-242 and Pu-244 using Electromagnetic Isotope Separation (EMIS) and/or nuclear reactor irradiation which involves irradiation of Pu in the HFIR at ORNL to "burnout" Pu-239 and Pu-240. Both techniques have been conducted in the past at ORNL to enrich Pu.

Proposed Milestones

Activities	Due Date
Evaluate enrichment options	6/30/2014
Complete calculations for enrichment by irradiation	9/30/2014
Fabricate test Pu target and irradiate in HFIR	6/30/2015
Develop EMIS concept and develop system requirements	6/30/2015
Submit final report	9/30/2015

Benefits

This study will clarify the technical path forward and supports budget request to establish Pu minor isotope enrichment in the U.S. The project can use new EMIS technology being developed at ORNL for stable isotope enrichment.

- Provide enriched Pu-244 for a number of critical applications and users
  - Isotope Dilution Mass Spectrometry (IDMS), highly accurate and precise measurements of plutonium in nuclear forensics, industrial and intelligence applications
  - Pu-244 analytical standards were developed for unique applications in International Nonproliferation and Nuclear Security
  - Other important users are the U.S. intelligence community and environmental forensic studies
- Provides enriched Pu-242 for use by Defense Programs

Available Pu material is not enriched to meet programmatic needs.

Any Thoughts?